

CLAIMS

We claim:

1. A method for managing the flow of a plurality of aircraft at an aviation resource, based upon specified data and operational goals pertaining to said aircraft and resource and the control of aircraft arrival fix times at said resource by a system manager charged with managing said resource, said method comprising the steps of:
 - collecting and storing said specified data and operational goals,
 - processing said specified data to predict an initial arrival fix time for each of said aircraft at said resource,
 - specifying a goal function which is defined in terms of arrival fix times and whose value is a measure of how well said aircraft meet said operational goals based on achieving specified arrival fix times,
 - computing an initial value of said goal function using said predicted initial arrival fix times,
 - utilizing said goal function to identify potential arrival fix times to which said arrival fix times can be changed from said predicted, initial arrival fix times so as to result in the value of said goal function indicating a higher degree of attainment of said operational goals than that indicated by said initial value of said goal function,
 - if said utilization step yields a goal function whose value is higher than said initial goal function value, defining requested arrival fix times to be those arrival fix times associated with said higher goal function value,
 - if said utilization step does not yield a goal function whose value is higher than said initial goal function value, defining requested arrival fix times to be said predicted, initial arrival fix times,
 - communicating said requested arrival fix times to said system manager to determine whether authorization may be obtained from said system manager for said aircraft to use said requested arrival fix times,
 - if said arrival fix times authorization is obtained, establishing said requested arrival fix times as the targeted arrival fix times of said aircraft,

1 if said arrival fix times authorization is not obtained, continuing to use said
2 goal function to identify potential arrival fix times which can be communicated to
3 said system manager until arrival fix times authorization is obtained.

4 2. A method as recited in Claim 1, further comprising the step of:

5 communicating said targeted arrival fix times to said aircraft so that said
6 aircraft have the information needed to change their trajectories to meet said targeted
7 arrival fix times.

8 3. A method as recited in Claim 1, further comprising the step of:

9 monitoring the ongoing temporal changes in said specified data so as to
10 identify the updated and current values of said specified data,

11 processing said updated values of said specified data to predict updated arrival
12 fix times for each of said aircraft at said resource,

13 computing an updated value of said goal function using said updated arrival
14 fix times,

15 assessing said updated goal function value to determine whether its value and
16 associated updated arrival fix times yield a higher degree of attainment of said
17 operational goals than used as the basis for said requested arrival fix times,

18 if said updated goal function value implies a higher degree of attainment of
19 said operational goals than that used as the basis for said requested arrival fix times,
20 defining new requested arrival fix times to be said updated arrival fix times,

21 if said updated goal function value does not imply a higher degree of
22 attainment of said operational goals than that used as the basis for said requested
23 arrival fix times, utilizing said goal function to identify new, requested arrival fix
24 times to which said targeted arrival fix times can be changed so as to result in the
25 value of said goal function indicating a higher degree of attainment of said
26 operational goals than that indicated by said updated arrival fix times,

27 communicating said new requested arrival fix times to said system manager to
28 determine whether authorization may be obtained from said system manager for said
29 aircraft to use said new requested arrival fix times as their new targeted, arrival fix
30 times.

31 4. A method as recited in Claim 2, further comprising the step of:

1 monitoring the ongoing temporal changes in said specified data so as to
2 identify the updated and current values of said specified data,
3 processing said updated values of said specified data to predict updated arrival
4 fix times for each of said aircraft at said resource,
5 computing an updated value of said goal function using said updated arrival
6 fix times,
7 assessing said updated goal function value to determine whether its value and
8 associated updated arrival fix times yield a higher degree of attainment of said
9 operational goals than used as the basis for said requested arrival fix times,
10 if said updated goal function value implies a higher degree of attainment of
11 said operational goals than that used as the basis for said requested arrival fix times,
12 defining new requested arrival fix times to be said updated arrival fix times,
13 if said updated goal function value does not imply a higher degree of
14 attainment of said operational goals than that used as the basis for said requested
15 arrival fix times, utilizing said goal function to identify new, requested arrival fix
16 times to which said targeted arrival fix times can be changed so as to result in the
17 value of said goal function indicating a higher degree of attainment of said
18 operational goals than that indicated by said updated arrival fix times,
19 communicating said new requested arrival fix times to said system manager to
20 determine whether authorization may be obtained from said system manager for said
21 aircraft to use said new requested arrival fix times as their new targeted, arrival fix
22 times.

23 5. A method as recited in Claim 3, wherein said system manager determines whether
24 to authorize the use of a requested arrival fix time by utilizing an authority goal
25 function, said function being defined in terms of arrival fix times and whose value is a
26 measure of the degree of attainment by said system manager of said operational goals
27 of said system manager.

28 6. A method as recited in Claim 4, wherein said system manager determines whether
29 to authorize the use of a requested arrival fix time by utilizing an authority goal
30 function, said function being defined in terms of arrival fix times and whose value is a

1 measure of the degree of attainment by said system manager of said operational goals
2 of said system manager.

3 7. A method as recited in Claim 3, wherein said specified data is chosen from the
4 group consisting of the temporally varying positions and trajectories of said aircraft,
5 the temporally varying weather conditions surrounding said aircraft and resource, the
6 flight handling characteristics of said aircraft, the safety regulations pertaining to said
7 aircraft and resource, the position and capacity of said resource.

8 8. A method as recited in Claim 4, wherein said specified data is chosen from the
9 group consisting of the temporally varying positions and trajectories of said aircraft,
10 the temporally varying weather conditions surrounding said aircraft and resource, the
11 flight handling characteristics of said aircraft, the safety regulations pertaining to said
12 aircraft and resource, the position and capacity of said resource.

13 9. A method as recited in Claim 5, wherein said specified data is chosen from the
14 group consisting of the temporally varying positions and trajectories of said aircraft,
15 the temporally varying weather conditions surrounding said aircraft and resource, the
16 flight handling characteristics of said aircraft, the safety regulations pertaining to said
17 aircraft and resource, the position and capacity of said resource.

18 10. A method as recited in Claim 6, wherein said specified data is chosen from the
19 group consisting of the temporally varying positions and trajectories of said aircraft,
20 the temporally varying weather conditions surrounding said aircraft and resource, the
21 flight handling characteristics of said aircraft, the safety regulations pertaining to said
22 aircraft and resource, the position and capacity of said resource.

23 11. A computer program product in a computer readable memory for controlling a
24 processor to allow one to manage the flow of a plurality of aircraft at an aviation
25 resource, based upon specified data and operational goals pertaining to said aircraft
26 and resource and the control of aircraft arrival fix times at said resource by a system
27 manager charged with managing said resource, said computer program product
28 comprising:

29 a means for collecting and storing said specified data and operational goals,
30 a means for processing said specified data to predict an initial arrival fix time

31 for each of said aircraft at said resource,

1 a means for specifying a goal function which is defined in terms of arrival fix
2 times and whose value is a measure of how well said aircraft meet said operational
3 goals based on achieving specified arrival fix times,

4 a means for computing an initial value of said goal function using said
5 predicted initial arrival fix times,

6 a means for utilizing said goal function to identify potential arrival fix times to
7 which said arrival fix times can be changed from said predicted, initial arrival fix
8 times so as to result in the value of said goal function indicating a higher degree of
9 attainment of said operational goals than that indicated by said initial value of said
10 goal function,

11 if said utilization step yields a goal function whose value is higher than said
12 initial goal function value, a means for defining requested arrival fix times to be those
13 arrival fix times associated with said higher goal function value,

14 if said utilization step does not yield a goal function whose value is higher
15 than said initial goal function value, a means for defining requested arrival fix times
16 to be said predicted, initial arrival fix times,

17 a means for communicating said requested arrival fix times to said system
18 manager to determine whether authorization may be obtained from said system
19 manager for said aircraft to use said requested arrival fix times,

20 if said arrival fix times authorization is obtained, a means for establishing said
21 requested arrival fix times as the targeted arrival fix times of said aircraft,

22 if said arrival fix times authorization is not obtained, a means for continuing to
23 use said goal function to identify potential arrival fix times which can be
24 communicated to said system manager until arrival fix times authorization is
25 obtained.

26 12. A computer program product as recited in Claim 11, further comprising:

27 a means for communicating said targeted arrival fix times to said aircraft so
28 that said aircraft have the information needed to change their trajectories to meet said
29 targeted arrival fix times.

30 13. A computer program product as recited in Claim 11, further comprising:

1 a means for monitoring the ongoing temporal changes in said specified data so
2 as to identify the updated and current values of said specified data,

3 a means for processing said updated values of said specified data to predict
4 updated arrival fix times for each of said aircraft at said resource,

5 a means for computing an updated value of said goal function using said
6 updated arrival fix times,

7 a means for assessing said updated goal function value to determine whether
8 its value and associated updated arrival fix times yield a higher degree of attainment
9 of said operational goals than used as the basis for said requested arrival fix times,

10 if said updated goal function value implies a higher degree of attainment of
11 said operational goals than that used as the basis for said requested arrival fix times, a
12 means for defining new requested arrival fix times to be said updated arrival fix
13 times,

14 if said updated goal function value does not imply a higher degree of
15 attainment of said operational goals than that used as the basis for said requested
16 arrival fix times, a means for utilizing said goal function to identify new, requested
17 arrival fix times to which said targeted arrival fix times can be changed so as to result
18 in the value of said goal function indicating a higher degree of attainment of said
19 operational goals than that indicated by said updated arrival fix times,

20 a means for communicating said new requested arrival fix times to said
21 system manager to determine whether authorization may be obtained from said
22 system manager for said aircraft to use said new requested arrival fix times as their
23 new targeted, arrival fix times.

24 14. A computer program product as recited in Claim 12, further comprising:

25 a means for monitoring the ongoing temporal changes in said specified data so
26 as to identify the updated and current values of said specified data,

27 a means for processing said updated values of said specified data to predict
28 updated arrival fix times for each of said aircraft at said resource,

29 a means for computing an updated value of said goal function using said
30 updated arrival fix times,

1 a means for assessing said updated goal function value to determine whether
2 its value and associated updated arrival fix times yield a higher degree of attainment
3 of said operational goals than used as the basis for said requested arrival fix times,

4 if said updated goal function value implies a higher degree of attainment of
5 said operational goals than that used as the basis for said requested arrival fix times, a
6 means for defining new requested arrival fix times to be said updated arrival fix
7 times,

8 if said updated goal function value does not imply a higher degree of
9 attainment of said operational goals than that used as the basis for said requested
10 arrival fix times, a means for utilizing said goal function to identify new, requested
11 arrival fix times to which said targeted arrival fix times can be changed so as to result
12 in the value of said goal function indicating a higher degree of attainment of said
13 operational goals than that indicated by said updated arrival fix times,

14 a means for communicating said new requested arrival fix times to said
15 system manager to determine whether authorization may be obtained from said
16 system manager for said aircraft to use said new requested arrival fix times as their
17 new targeted, arrival fix times.

18 15. A computer program product as recited in Claim 13, wherein said system
19 manager determines whether to authorize the use of a specified arrival fix time by
20 utilizing an authority goal function, said function being defined in terms of arrival fix
21 times and whose value is a measure of the degree of attainment by said system
22 manager of said operational goals of said system manager.

23 16. A computer program product as recited in Claim 14, wherein said system
24 manager determines whether to authorize the use of a specified arrival fix time by
25 utilizing an authority goal function, said function being defined in terms of arrival fix
26 times and whose value is a measure of the degree of attainment by said system
27 manager of said operational goals of said system manager.

28 17. A computer program product as recited in Claim 13, wherein said specified data
29 is chosen from the group consisting of the temporally varying positions and
30 trajectories of said aircraft, the temporally varying weather conditions surrounding
31 said aircraft and resource, the flight handling characteristics of said aircraft, the safety

1 regulations pertaining to said aircraft and resource, the position and capacity of said
2 resource.

3 18. A computer program product as recited in Claim 14, wherein said specified data
4 is chosen from the group consisting of the temporally varying positions and
5 trajectories of said aircraft, the temporally varying weather conditions surrounding
6 said aircraft and resource, the flight handling characteristics of said aircraft, the safety
7 regulations pertaining to said aircraft and resource, the position and capacity of said
8 resource.

9 19. A computer program product as recited in Claim 15, wherein said specified data
10 is chosen from the group consisting of the temporally varying positions and
11 trajectories of said aircraft, the temporally varying weather conditions surrounding
12 said aircraft and resource, the flight handling characteristics of said aircraft, the safety
13 regulations pertaining to said aircraft and resource, the position and capacity of said
14 resource.

15 20. A computer program product as recited in Claim 16, wherein said specified data
16 is chosen from the group consisting of the temporally varying positions and
17 trajectories of said aircraft, the temporally varying weather conditions surrounding
18 said aircraft and resource, the flight handling characteristics of said aircraft, the safety
19 regulations pertaining to said aircraft and resource, the position and capacity of said
20 resource.

21 21. A system, including a processor, memory, display and input device, that allows
22 one to manage the flow of a plurality of aircraft at an aviation resource, based upon
23 specified data and operational goals pertaining to said aircraft and resource and the
24 control of aircraft arrival fix times at said resource by a system manager charged with
25 managing said resource, said system comprising:

26 a means for collecting and storing said specified data and operational goals,

27 a means for processing said specified data to predict an initial arrival fix time
28 for each of said aircraft at said resource,

29 a means for specifying a goal function which is defined in terms of arrival fix
30 times and whose value is a measure of how well said aircraft meet said operational
31 goals based on achieving specified arrival fix times,

1 a means for computing an initial value of said goal function using said
2 predicted initial arrival fix times,

3 a means for utilizing said goal function to identify potential arrival fix times to
4 which said arrival fix times can be changed from said predicted, initial arrival fix
5 times so as to result in the value of said goal function indicating a higher degree of
6 attainment of said operational goals than that indicated by said initial value of said
7 goal function,

8 if said utilization step yields a goal function whose value is higher than said
9 initial goal function value, a means for defining requested arrival fix times to be those
10 arrival fix times associated with said higher goal function value,

11 if said utilization step does not yield a goal function whose value is higher
12 than said initial goal function value, a means for defining requested arrival fix times
13 to be said predicted, initial arrival fix times,

14 a means for communicating said requested arrival fix times to said system
15 manager to determine whether authorization may be obtained from said system
16 manager for said aircraft to use said requested arrival fix times,

17 if said arrival fix times authorization is obtained, a means for establishing said
18 requested arrival fix times as the targeted arrival fix times of said aircraft,

19 if said arrival fix times authorization is not obtained, a means for continuing to
20 use said goal function to identify potential arrival fix times which can be
21 communicated to said system manager until arrival fix times authorization is
22 obtained.

23 22. A system as recited in Claim 21, further comprising:

24 a means for communicating said targeted arrival fix times to said aircraft so
25 that said aircraft have the information needed to change their trajectories to meet said
26 targeted arrival fix times.

27 23. A system as recited in Claim 21, further comprising:

28 a means for monitoring the ongoing temporal changes in said specified data so
29 as to identify the updated and current values of said specified data,

30 a means for processing said updated values of said specified data to predict
31 updated arrival fix times for each of said aircraft at said resource,

1 a means for computing an updated value of said goal function using said
2 updated arrival fix times,

3 a means for assessing said updated goal function value to determine whether
4 its value and associated updated arrival fix times yield a higher degree of attainment
5 of said operational goals than used as the basis for said requested arrival fix times,

6 if said updated goal function value implies a higher degree of attainment of
7 said operational goals than that used as the basis for said requested arrival fix times, a
8 means for defining new requested arrival fix times to be said updated arrival fix
9 times,

10 if said updated goal function value does not imply a higher degree of
11 attainment of said operational goals than that used as the basis for said requested
12 arrival fix times, a means for utilizing said goal function to identify new, requested
13 arrival fix times to which said targeted arrival fix times can be changed so as to result
14 in the value of said goal function indicating a higher degree of attainment of said
15 operational goals than that indicated by said updated arrival fix times,

16 a means for communicating said new requested arrival fix times to said
17 system manager to determine whether authorization may be obtained from said
18 system manager for said aircraft to use said new requested arrival fix times as their
19 new targeted, arrival fix times.

20 24. A system as recited in Claim 22, further comprising:

21 a means for monitoring the ongoing temporal changes in said specified data so
22 as to identify the updated and current values of said specified data,

23 a means for processing said updated values of said specified data to predict
24 updated arrival fix times for each of said aircraft at said resource,

25 a means for computing an updated value of said goal function using said
26 updated arrival fix times,

27 a means for assessing said updated goal function value to determine whether
28 its value and associated updated arrival fix times yield a higher degree of attainment
29 of said operational goals than used as the basis for said requested arrival fix times,

30 if said updated goal function value implies a higher degree of attainment of
31 said operational goals than that used as the basis for said requested arrival fix times, a

1 means for defining new requested arrival fix times to be said updated arrival fix
2 times,

3 if said updated goal function value does not imply a higher degree of
4 attainment of said operational goals than that used as the basis for said requested
5 arrival fix times, a means for utilizing said goal function to identify new, requested
6 arrival fix times to which said targeted arrival fix times can be changed so as to result
7 in the value of said goal function indicating a higher degree of attainment of said
8 operational goals than that indicated by said updated arrival fix times,

9 a means for communicating said new requested arrival fix times to said
10 system manager to determine whether authorization may be obtained from said
11 system manager for said aircraft to use said new requested arrival fix times as their
12 new targeted, arrival fix times.

13 25. A system as recited in Claim 23, wherein said system manager determines
14 whether to authorize the use of a specified arrival fix time by utilizing an authority
15 goal function, said function being defined in terms of arrival fix times and whose
16 value is a measure of the degree of attainment by said system manager of said
17 operational goals of said system manager.

18 26. A system as recited in Claim 24, wherein said system manager determines
19 whether to authorize the use of a specified arrival fix time by utilizing an authority
20 goal function, said function being defined in terms of arrival fix times and whose
21 value is a measure of the degree of attainment by said system manager of said
22 operational goals of said system manager.

23 27. A system as recited in Claim 23, wherein said specified data is chosen from the
24 group consisting of the temporally varying positions and trajectories of said aircraft,
25 the temporally varying weather conditions surrounding said aircraft and resource, the
26 flight handling characteristics of said aircraft, the safety regulations pertaining to said
27 aircraft and resource, the position and capacity of said resource.

28 28. A system as recited in Claim 24, wherein said specified data is chosen from the
29 group consisting of the temporally varying positions and trajectories of said aircraft,
30 the temporally varying weather conditions surrounding said aircraft and resource, the

1 flight handling characteristics of said aircraft, the safety regulations pertaining to said
2 aircraft and resource, the position and capacity of said resource.

3 29. A system as recited in Claim 25, wherein said specified data is chosen from the
4 group consisting of the temporally varying positions and trajectories of said aircraft,
5 the temporally varying weather conditions surrounding said aircraft and resource, the
6 flight handling characteristics of said aircraft, the safety regulations pertaining to said
7 aircraft and resource, the position and capacity of said resource.

8 30. A system as recited in Claim 26, wherein said specified data is chosen from the
9 group consisting of the temporally varying positions and trajectories of said aircraft,
10 the temporally varying weather conditions surrounding said aircraft and resource, the
11 flight handling characteristics of said aircraft, the safety regulations pertaining to said
12 aircraft and resource, the position and capacity of said resource.

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